AIR CONDITIONING

AUTOMATIC SYSTEM

Service Specifications

SPECIFICATIONS (AUTOMATIC A/C)

Application	Specification
Compressor Type	
Sanden	SD7-V16
Compressor Belt Tension	(1)
Compressor Clutch Plate Clearance	.015-.023" (.4-.8 mm)
Refrigerant (R-134a) Capacity	
Sanden	24.7 +/- 1.8 oz. (700 +/- 50 g)
System Oil Capacity	
Sanden	(2) 4.56 fl. oz. (135 cc)
System Operating Pressures (3)	
High Side	203 psi (14 bar)
Low Side	17.4 psi (1.2 bar)

(1) All engines use automatic belt tensioner.

(2) Use PAG Refrigerant Oil (Part No. G 052 154 A2), or equivalent.

(3) A/C pressure specs measured at engine RPM at 1500, fresh air blower on high speed, and A/C adjusted to max. cooling. Ambient temperature at 68-86°F (20°-30° C).

Torque Specifications

TORQUE SPECIFICATIONS (A/C)

Application	Ft. Lbs. (N.m)
A/C Clutch Plate	
Sanden, Nut (1)	11 (15)
A/C Compressor Mount Bolt	33 (45)
Idler Pulley Bolt (1.9L TDI)	18 (25)
Refrigerant Line	
To-Receiver Drier Bolts	11 (15)
Hose (Compressor-To-Condensor) At Condensor	11 (15)

Block-To-Compressor Bolt	15 (20)
	INCH Lbs. (N.m)
A/C Pressure Switch or High Pressure Switch	44 (5)
Condsenor Mounting Screws	71 (8)
Refrigerant Line Block-To-Evaporator Core Bolt	71 (8)
(1) Always replace Sanden clutch plate nut, if removed.	

MANUAL SYSTEM

Service Specifications

NOTE: See service specifications under AUTOMATIC SYSTEM .

Torque Specifications

NOTE: See torque specifications under AUTOMATIC SYSTEM .

BATTERY

BATTERY PRECAUTIONS

- Obtain anti-theft radio security code.
- Do not loosen or remove ground strap from body. Disconnect terminal from battery only.
- Disconnecting the battery positive (B+) terminal must only be performed as required to remove battery from vehicle, and must only be carried out after the negative (-) terminal is disconnected.

AFTER CONNECTING BATTERY CABLES

After connecting batterycables, please note the following:

- Check for any stored Diagnostic Trouble Codes (DTCs) using a scan tool. Clear as necessary.
- Power windows (if equipped): Completely open and close all power windows.
- Input anti-theft radio code and check radio, CD and tape player functions as applicable.
- Check and reset clock to local time.

BATTERY LOAD TESTING SPECIFICATIONS

Amp Hour Rating	Cold Cranking Amps	Load - Amps	Minimum Voltage
61-80	300-380	300	9.0
81-110	380-500	300	9.5

BRAKES

BLEEDING SEQUENCE

Only use new brake fluid conforming to US standard FMVSS 116, DOT 4. Manufacturer recommends replacing brake fluid every 2 years.

BRAKELINE BLEEDING SEQUENCE

Application	Sequence
All Models	RR, LR, RF, LF

DISC BRAKES

NOTE: Manufacturer recommends changing brake fluid every 2 years.

Service Specifications

DISC BRAKE SPECIFICATIONS

Application	In. (mm)
ABS Speed Sensor-To-Rotor Gap	
Front & Rear	.003 (.08)
Front	
Beetle	
FS III Brake Disc	
Disc Diameter	11.023 (280)
Original Thickness	.866 (22)
Wear Limit	.748 (19)
Parallelism & Run-Out	(1)
FN 3 Brake Disc (2)	
Disc Diameter	11.338 (288)
Original Thickness	.984 (25)
Wear Limit	.866 (22)
Parallelism & Run-Out	(1)
Brake Pads	
Original Thickness	.551 (14)
Wear Limit (With Pad Backing Plate)	.276 (7)
Rear	
Beetle	
Brake Disc	
Disc Diameter	9.133 (232)
Original Thickness	.354 (9)
Wear Limit	.276 (7)

Brake Pads	
Original Thickness	.472 (12)
Wear Limit (With Pad Backing Plate)	.276 (7)

(1) Information is not available from manufacturer.

(2) FN 3 brake caliper is equipped with a brake pad retaining spring.

NOTE: Brake pad wear indicator light will come on when front pads are near wear limit. Light will go out when new pads are installed.

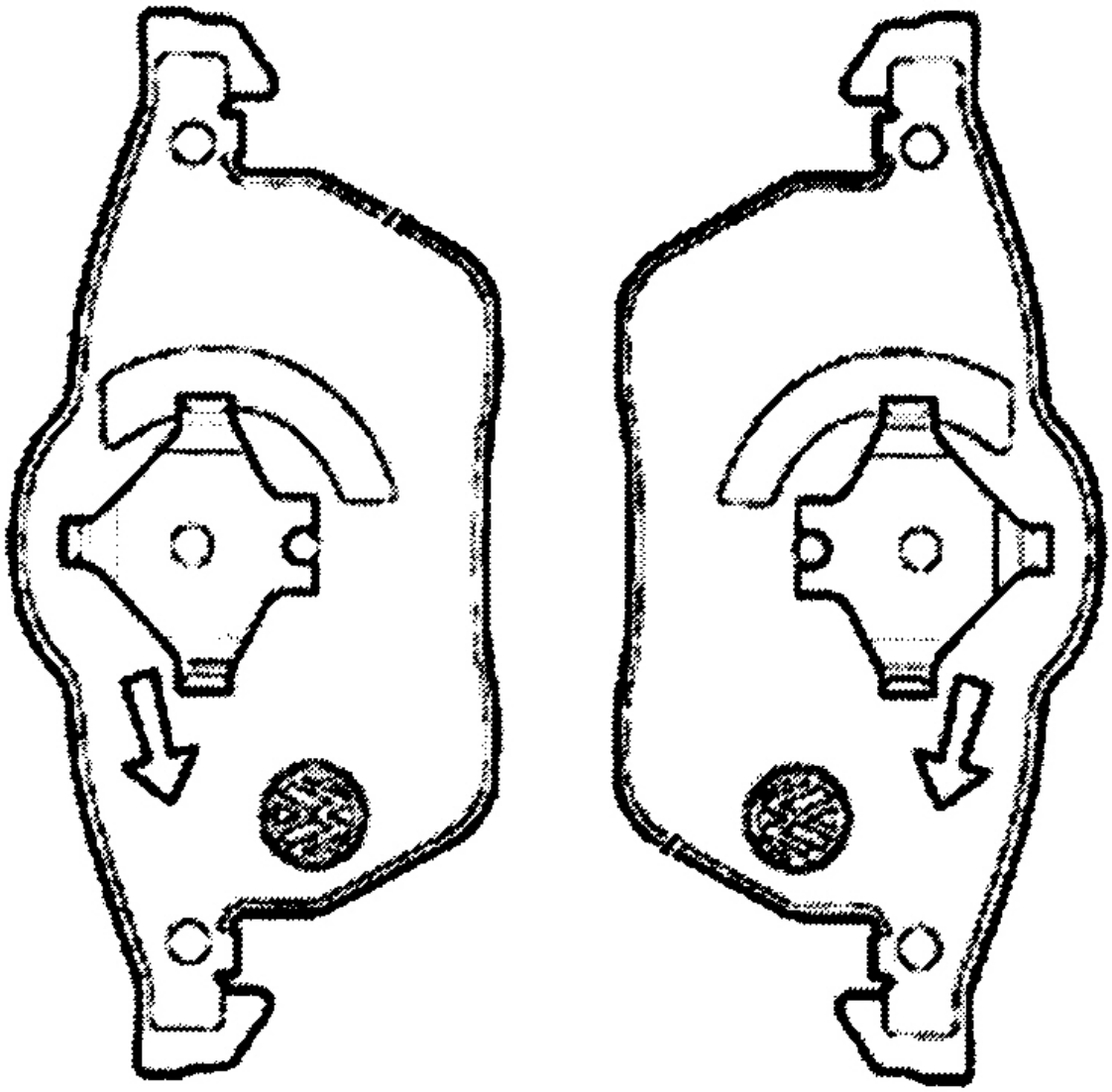

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Fig. 1: Positioning Front Brake Pads (Arrow Must Point Downwards - FN3 Caliper)

Courtesy of VOLKSWAGEN UNITED STATES, INC.

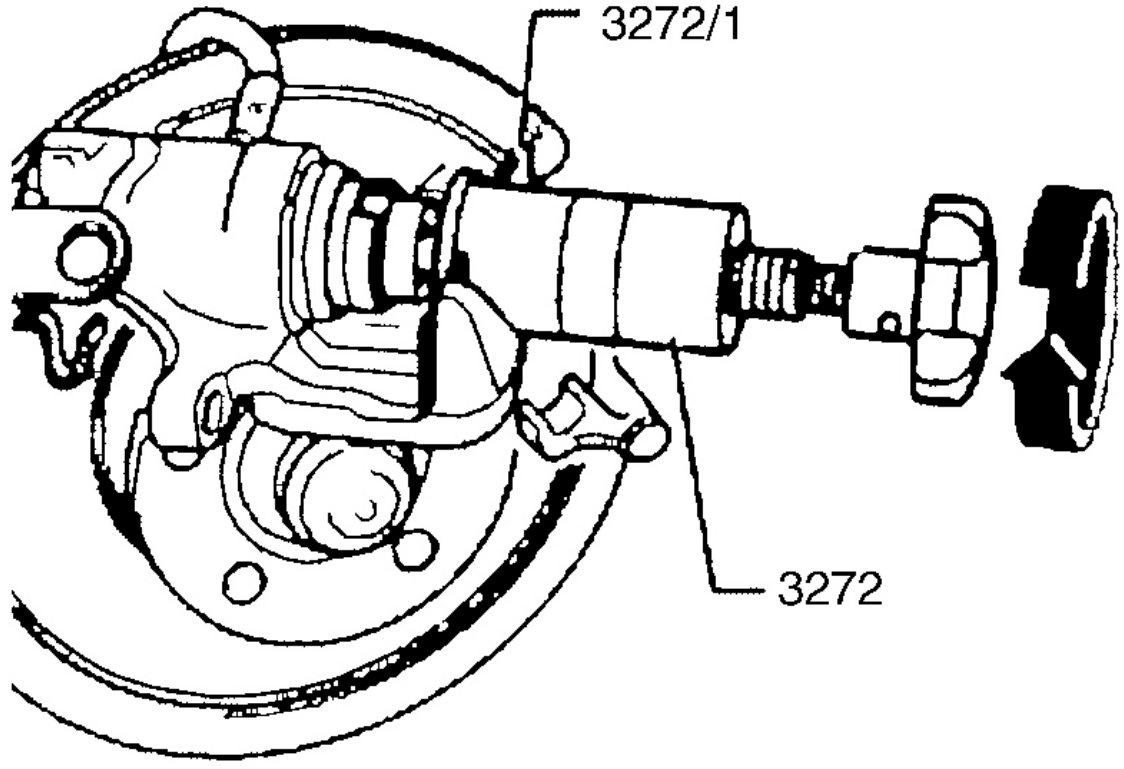

Fig. 2: Retracting Rear Brake Caliper Piston For Pad Installation
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Torque Specifications

TORQUE SPECIFICATIONS(BRAKES)

Application	Ft. Lbs. (N.m)
Front	
Beetle	
Brake Hose-To-Caliper Banjo Bolt	
FS III (280mm Diameter Disc)	26 (35)
FN 3 (288mm Diameter Disc) (1)	26 (35)
Caliper Guide Pins	21 (28)
Caliper Mount-to-Steering Knuckle Bolt	
FN 3 (288mm Diameter Disc) (1)	92 (125)
Rear	
Beetle	
Brake Hose-To-Caliper Banjo Bolt	26 (35)
Caliper Mount Bolts (2)	26 (35)

Caliper Mount-to-Spindle Bolts	48 (65)
Rear Wheel Bearing Hub Nut (2)	129 (175)
Wheel Lug Bolt	
Beetle	89 (120)
	INCH Lbs. (N.m)
ABS Speed Sensor Mounting Bolt	
Front & Rear	71 (8)

(1) FN 3 caliper is equipped with a brake pad retaining spring.

(2) Always replace all self-locking bolts.

CHARGING SYSTEM

GENERATOR

Service Specifications

GENERATOR APPLICATION

Application	Output AMPS
Beetle	70, 90 or 120

Torque Specifications

TORQUE SPECIFICATIONS (GENERATOR)

Application	Ft. Lbs. (N.m)
Generator Mount Bolt	
All Models	18 (25)
Generator Belt Pulley Nut	
Without Freewheel	48 +/- 4 (65 +/- 5)
With Freewheel	59 (80)
Serpentine Belt Tensioner-To-Engine Bolt	
All Models	18 (25)

DRIVE BELTS

ADJUSTMENT

NOTE: All engines are equipped with automatic belt tensioners. No adjustments are necessary.

DRIVE BELT ROUTING

Engine Identification Codes (1.8L - Engine Code AWP/AWV)

For 1.8L 4-cyl., engine identification is stamped on cylinder block at the connection between the engine and transmission. See **Fig. 3** . Additionally there is a sticker on the cylinder head cover with "Engine code" and "Serial number." The engine code is also included on the vehicle data plate.

The engine identification consists of up to nine characters (alphanumeric). The first portion (maximum 3 characters) represents the "engine code", the second portion (six characters) represents the serial number. If more than 999 999 engines were produced under the same code, the first of the six characters is replaced with a letter.

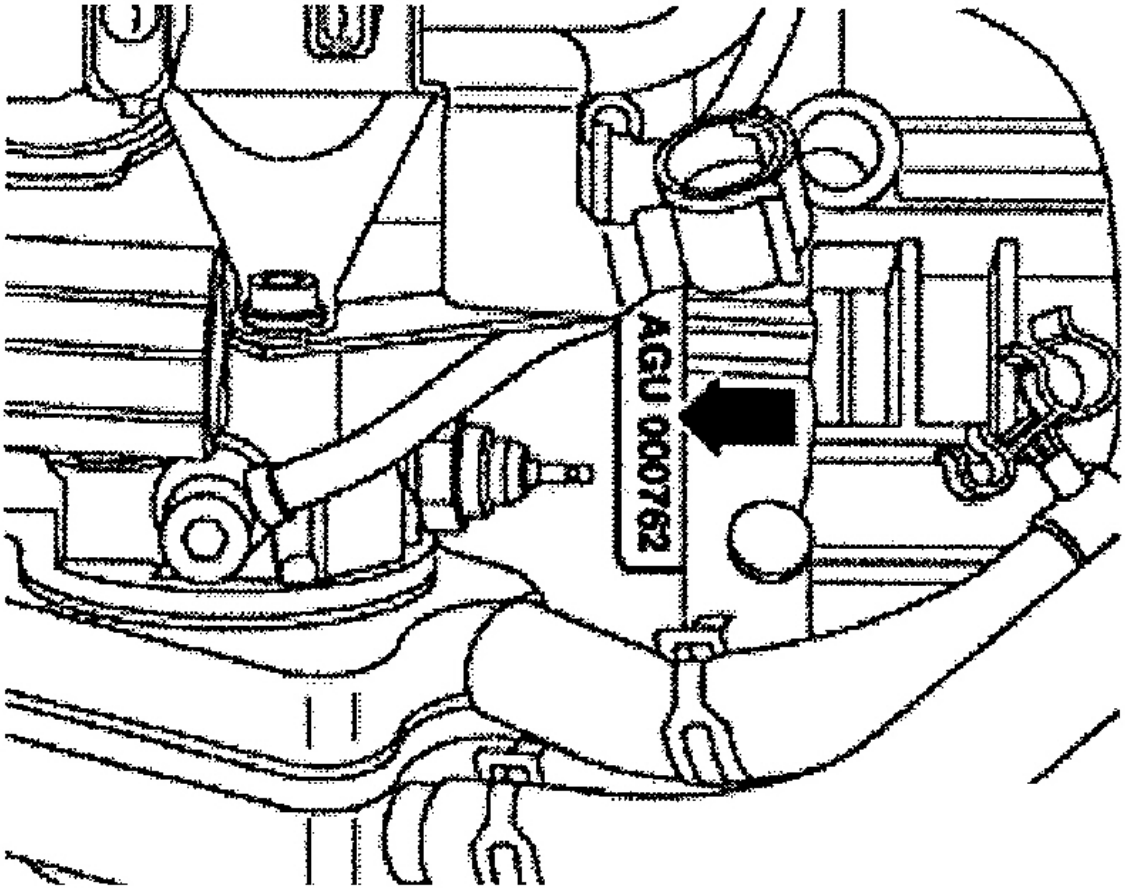

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Fig. 3: Locating Engine Identification Code (1.8L - On Engine Block)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Engine Identification Codes (1.9L Turbo Diesel - Engine Code ALH)

Engine number ("Engine code letters" and "Serial number") can be found between the Diesel injection pump and the exhaust manifold on the engine block. See **Fig. 4** . There is also a sticker on the timing belt guard showing "Engine code letters" and "Serial number". The engine number is also included on the vehicle data plate.

The engine identification consists of up to nine characters (alphanumeric). The first portion (maximum 3 characters) represents the "engine code", the second portion (six characters) represents the serial number. If more than 999 999 engines were produced under the same code, the first of the six characters is replaced with a letter.

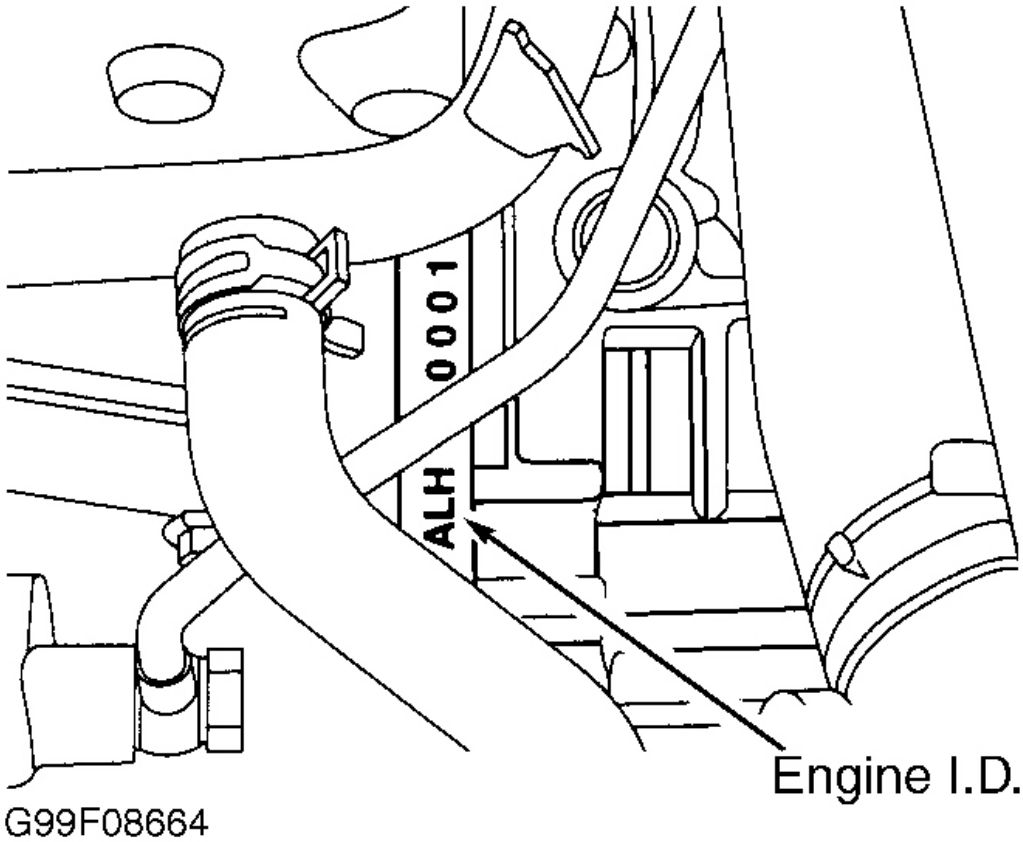

Fig. 4: Locating Engine Identification Code (1.9L Turbo Diesel)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Engine Identification Codes (2.0L - Engine Codes AVH & BDC)

The engine number ("Engine Code letters" and "Serial number") can be found on the front of the engine near the engine and transmission joint. See **Fig. 5** . The engine/serial number may also be located on a label on the cylinder head cover or timing belt cover. The engine/serial number is also included on the vehicle data plate.

The engine identification consists of up to nine characters (alphanumeric). The first portion (maximum 3 characters) represents the "engine code", the second portion (six characters) represents the serial number. If more than 999 999 engines were produced under the same code, the first of the six characters is replaced with a

letter.

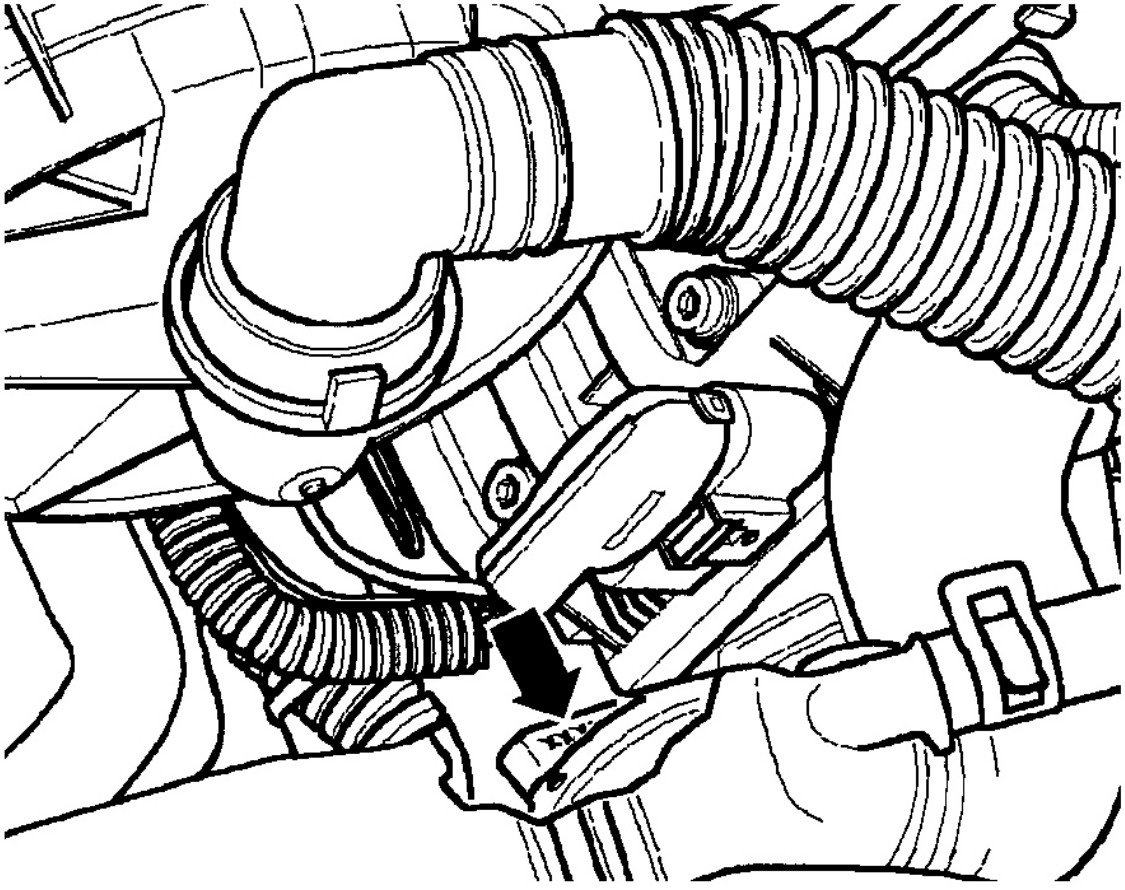

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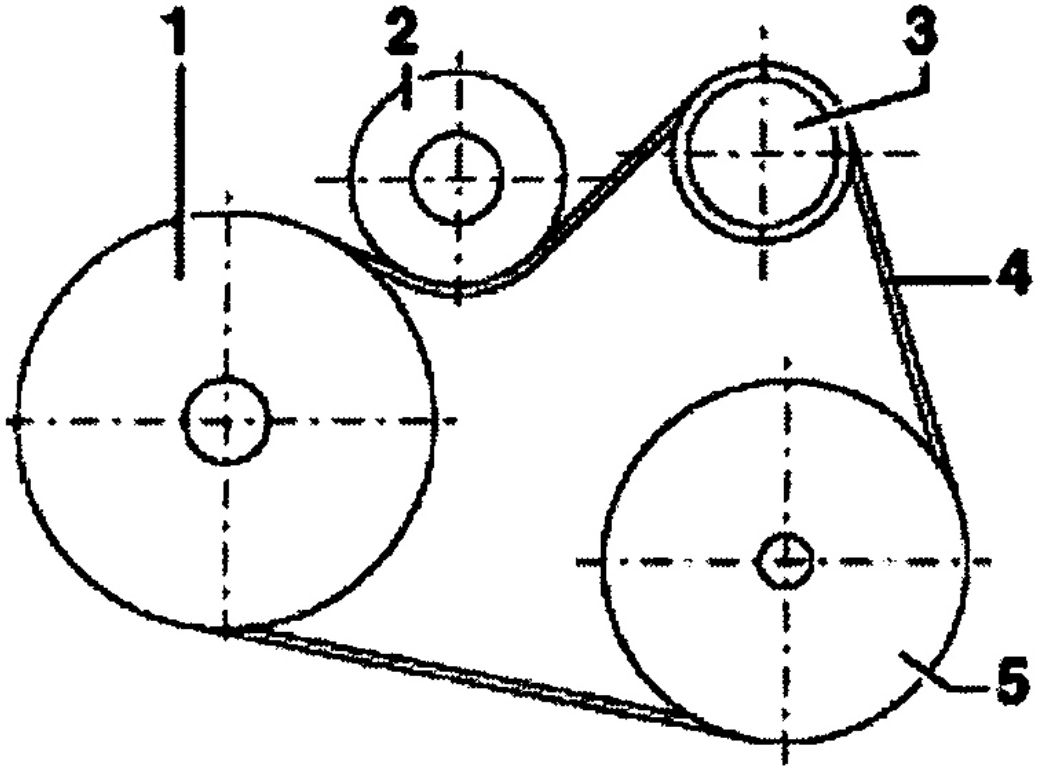
Fig. 5: Locating Engine Identification Code (2.0L)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

Routing Illustrations



1- Vibration damper/pulley
2- Tensioner
3- Pulley-generator
4- Ribbed belt
5- Pulley-power steering pump

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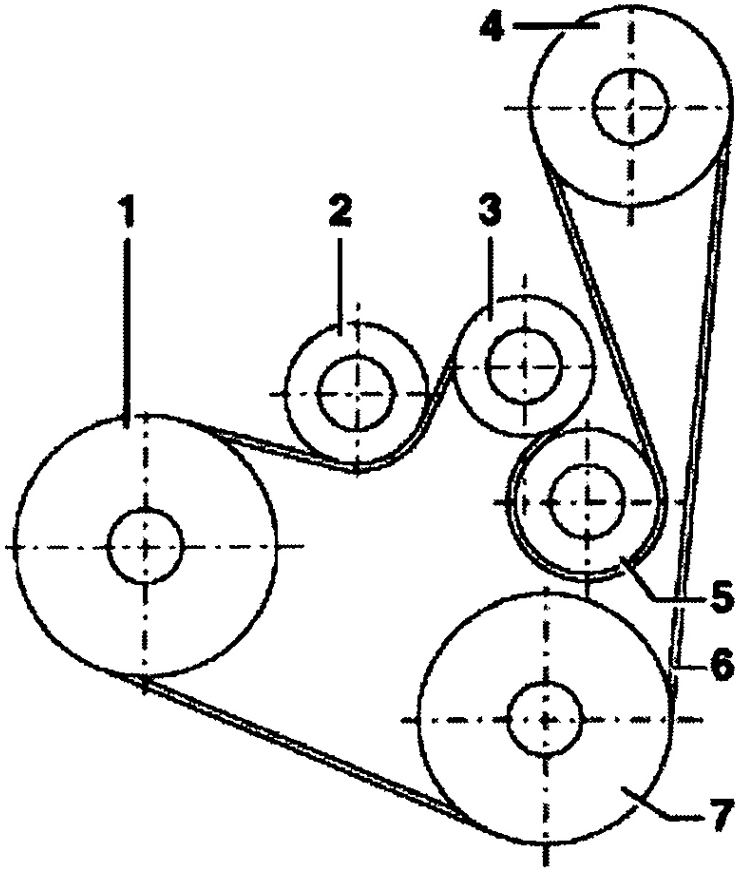
Fig. 6: Drive Belt Routing - 1.9L Turbo Diesel, Engine Code ALH (Without A/C)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1- Vibration damper/pulley
2- Tensioner
3- Pulley-generator
4- Pulley-power steering pump
5- Idler pulley
6- Ribbed belt
7- Pulley-A/C compressor

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Fig. 7: Drive Belt Routing - 1.9L Turbo Diesel, Engine Code ALH (With A/C)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

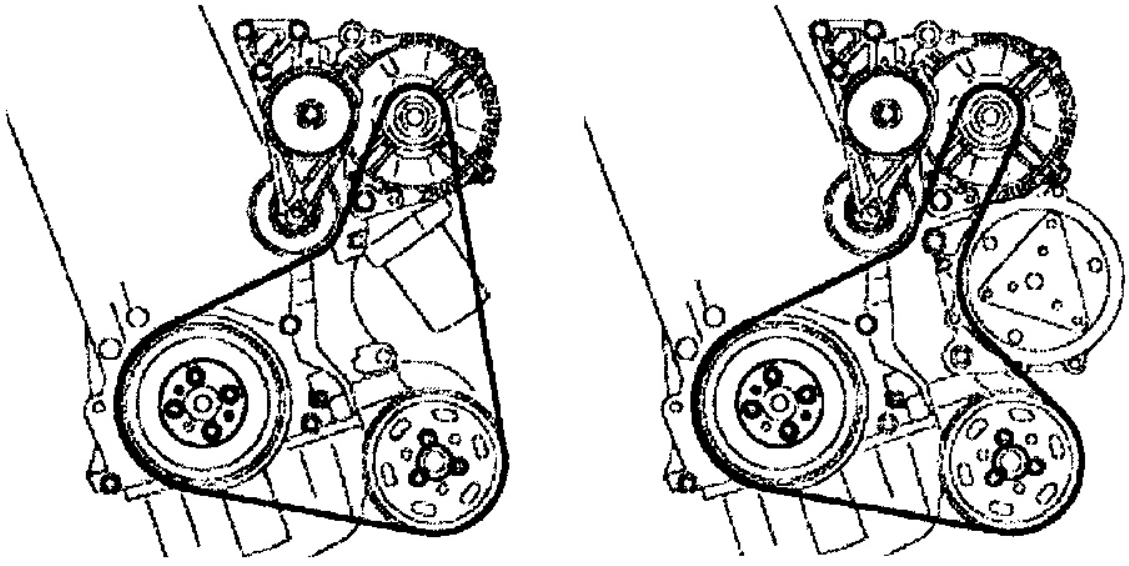

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Fig. 8: Drive Belt Routing - 1.8L, Engine Codes AWP/AWV & 2.0L, Engine Codes AVH & BDC (With & Without A/C)
Courtesy of AUDI OF AMERICA, INC.

ENGINE COOLING

SERVICE

CAUTION: Only use coolant additive G12 (according to TL VW 774 D).It is a red color. Do NOT mix G12 with any other coolant additive!

Cooling System Precautions

If the fluid in expansion tank is brown, G12 has been mixed with other coolant. In this is the case, coolant must be replaced. "G12" and coolant additives marked "In accordance with TL VW 774 D" prevent frost and corrosion damage, scaling and also raise the boiling point of the coolant. Therefore, cooling system must be filled year round with frost and corrosion protection additives.

A higher boiling point improves engine reliability under heavy load particularly in countries with tropical climates. Frost protection additives protect against frost to about -25 C (about -35 C in arctic climates). The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The anti-freeze ratio must be at least 40%.

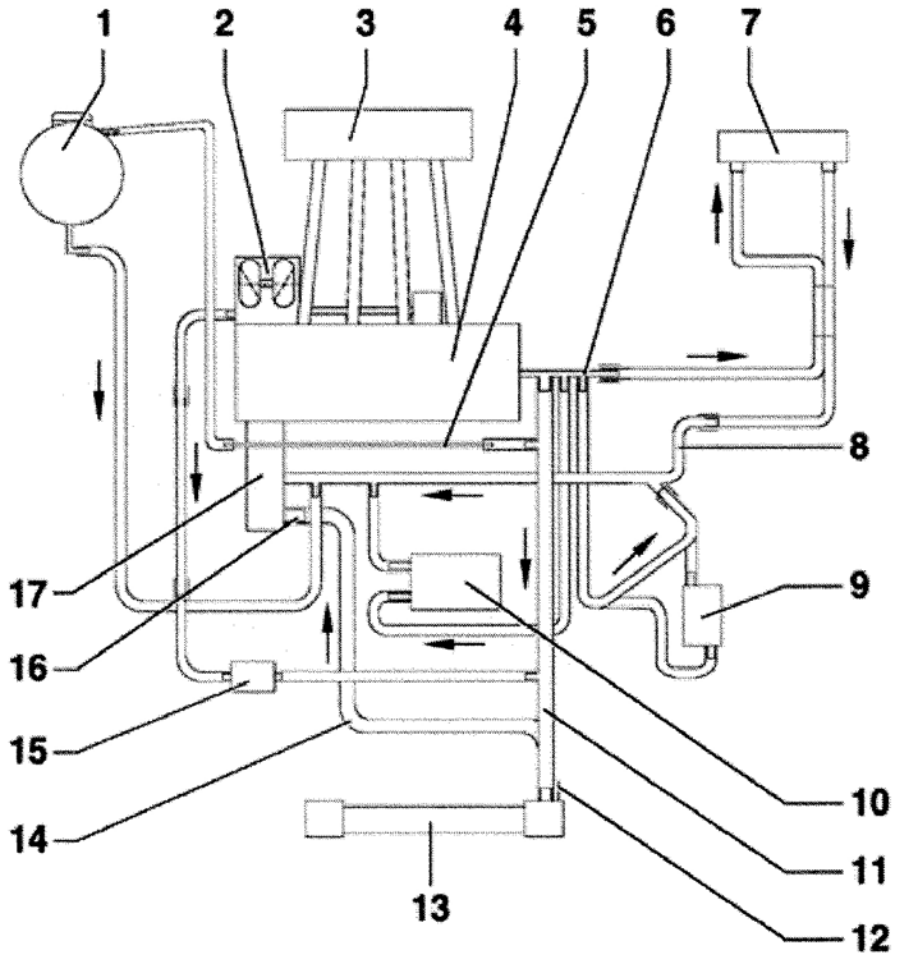
If for climatic reasons greater frost protection is required, the amount of G 12 can be increased, but only up to 60% (frost protection to about -40 C), otherwise frost protection and cooling effectiveness will be reduced.

Specifications

COOLING SYSTEM SPECIFICATIONS (1.8L - ENGINE CODE AWP/AWV)

Application	Specification
Volume (1)	5.3 Qts. (5.0L)
Thermostat	
Starts To Open	187°F (86°C)
Fully Open	216°F (102°C)
Opening Stroke	.28" (7mm)
Thermostatic Fan Switch (In Radiator)	
Stage 1	
On	198-207°F (92-97°C)
Off	183-196°F (84-91°C)
Stage 2	
On	210-221°F (99-105°C)
Off	196-208°F (91-98°C)
Reservoir Cap Opening Pressure	20-23 psi

(1) Only use coolant additive G12 (according to TL VW 774 D).It is a red color. Do NOT mix G12 with any other coolant additive! See **COOLING SYSTEM PRECAUTIONS** . Total coolant quantity may vary depending on vehicle equipment.



Vehicles with engine codes: AWP (only manual transmission), AWV (manual and automatic transmission)

1 - Expansion tank
2 - Turbocharger
3 - Intake manifold
4 - Cylinder head/cylinder block
5 - Upper coolant pipe
6 - Connection
7 - Heating system heat exchanger
8 - Lower coolant pipe
9 - ATF oil cooler

- ♦ Only on vehicles with automatic transmission

10 - Oil cooler
11 - Upper coolant hose
12 - Drain plug
13 - Radiator
14 - Lower coolant hose
15 - After-run coolant pump -V51-
16 - Coolant thermostat housing
17 - Coolant pump

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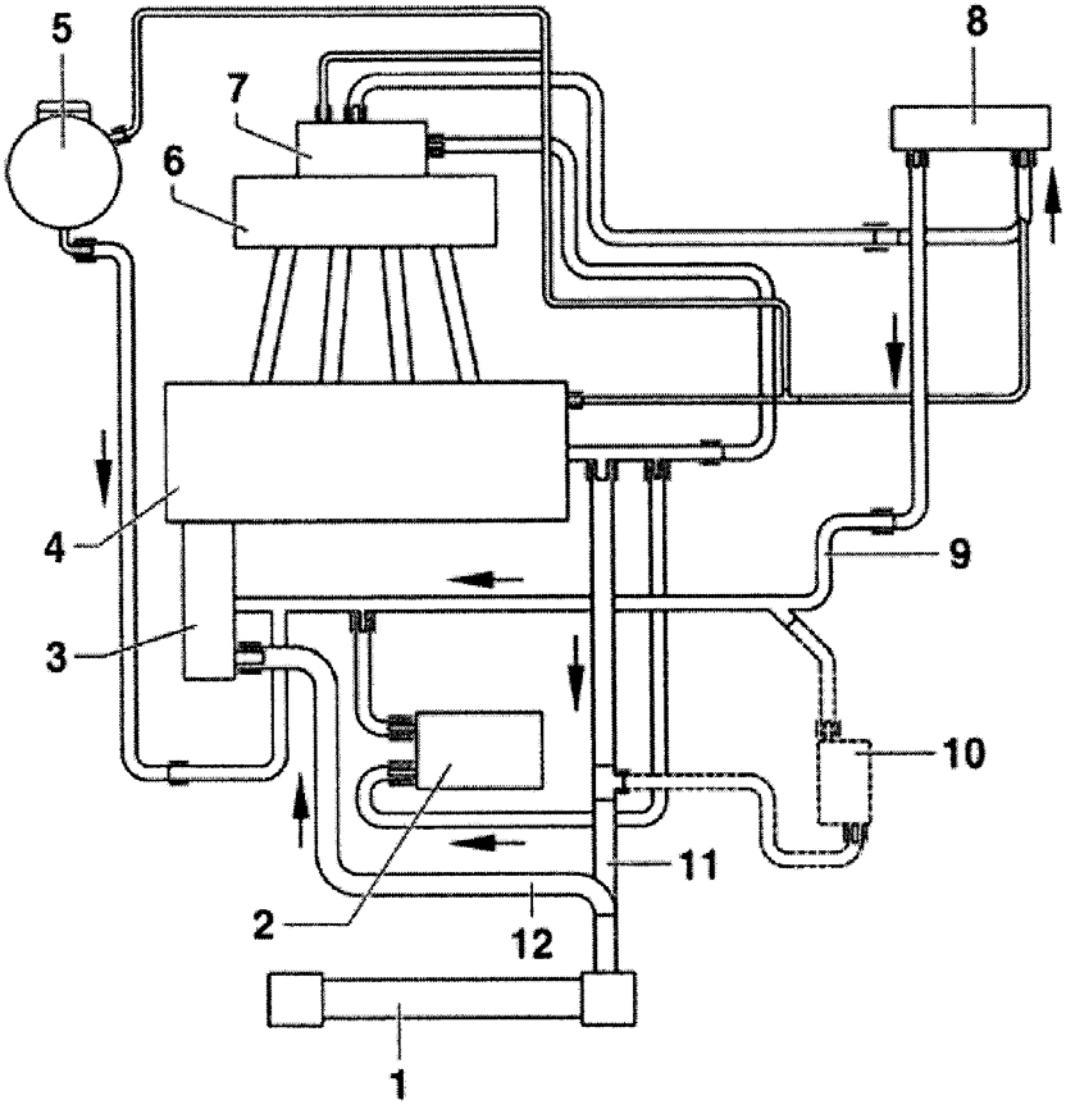
Fig. 9: Coolant Hose Routing Diagram (1.8L - Engine Codes AWP & AWV)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

COOLING SYSTEM SPECIFICATIONS (1.9L TURBO DIESEL - ENGINE CODE ALH)

Application	Specification
Volume (1)	6.3 Qts. (6.0L)
Thermostat	
Starts To Open	187°F (86°C)
Fully Open	221°F (105°C)
Opening Stroke	.28" (7mm)
Thermostatic Fan Switch (In Radiator)	
Stage 1	
On	198-207°F (92-97°C)
Off	183-196°F (84-91°C)
Stage 2	
On	210-221°F (99-105°C)
Off	196-208°F (91-98°C)
Reservoir Cap Opening Pressure	20-23 psi

(1) Only use coolant additive G12 (according to TL VW 774 D).It is a red color. Do NOT mix G12 with any other coolant additive! See **COOLING SYSTEM PRECAUTIONS** . Total coolant quantity may vary depending on vehicle equipment.



1 - Radiator
2 - Oil cooler
3 - Coolant pump
4 - Engine block
5 - Expansion tank
6 - Intake manifold
7 - EGR cooler
8 - Heating system heat exchanger
9 - Coolant pipe
10 - Transmission cooler
♦ Vehicles with automatic transmission
11 - Coolant hose, upper
12 - Coolant hose, lower

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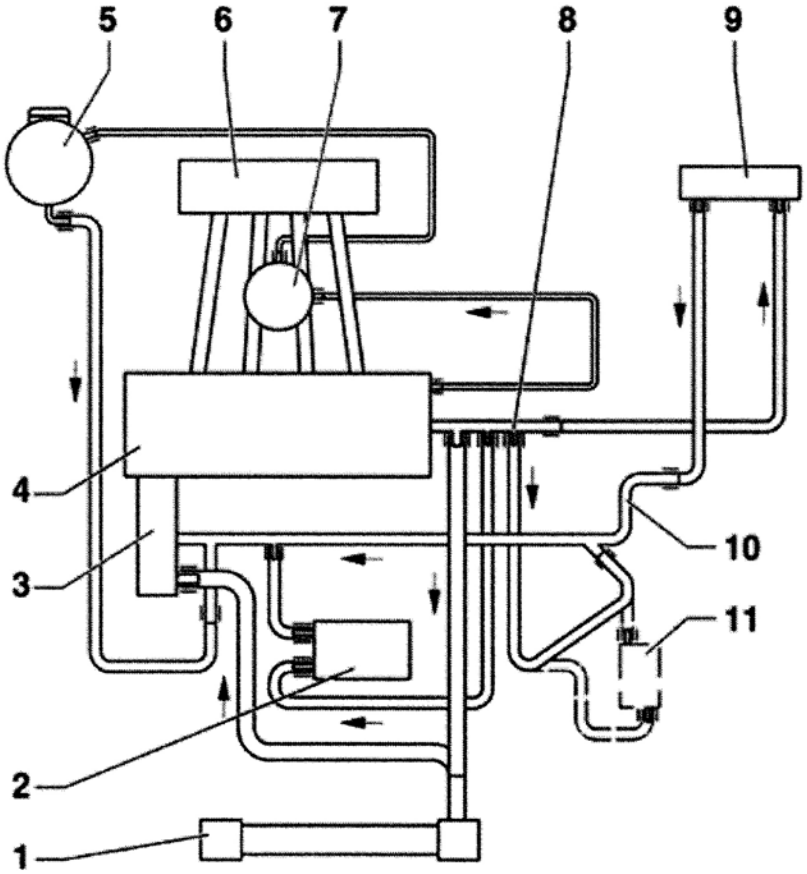
Fig. 10: Coolant Hose Routing Diagram (1.9L Turbo Diesel)

Courtesy of VOLKSWAGEN UNITED STATES, INC.

COOLING SYSTEM SPECIFICATIONS (2.0L - ENGINE CODES AVH & BDC)

Application	Specification
Volume (1)	5.3 Qts. (5.0L)
Thermostat	
Starts To Open	187°F (86°C)
Fully Open	221°F (105°C)
Opening Stroke	.28" (7mm)
Thermostatic Fan Switch (In Radiator)	
Stage 1	
On	198-207°F (92-97°C)
Off	183-196°F (84-91°C)
Stage 2	
On	210-221°F (99-105°C)
Off	196-208°F (91-98°C)
Reservoir Cap Opening Pressure	20-23 psi (1.4-1.6 Bar)

(1) Only use coolant additive G12 (according to TL VW 774 D).It is a red color. Do NOT mix G12 with any other coolant additive! See **COOLING SYSTEM PRECAUTIONS** . Total coolant quantity may vary depending on vehicle equipment.



1 - Radiator
2 - Oil cooler
3 - Coolant pump/coolant thermostat
4 - Cylinder head/engine block
5 - Expansion tank
6 - Intake manifold
7 - Throttle Control Module
8 - Connection
9 - Heat exchanger
10 - Coolant pipe
11 - Transmission cooler
♦ For vehicles with automatic transmission

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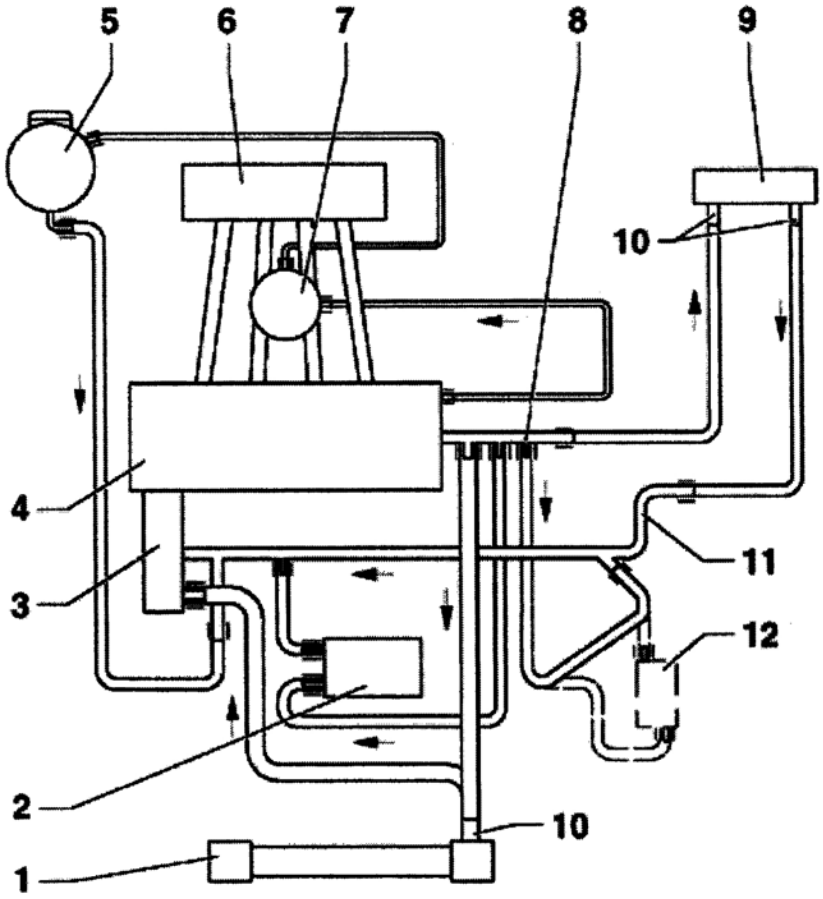
Fig. 11: Coolant Hose Routing Diagram (2.0L - Engine Code AVH)
Courtesy of VOLKSWAGEN UNITED STATES, INC.



1 - Radiator
2 - Oil cooler
3 - Coolant pump/coolant thermostat
4 - Cylinder head/cylinder block
5 - Expansion tank
6 - Intake manifold
7 - Throttle valve control module
8 - Connecting unions
9 - Heating system heat exchanger
10 - Quick-action coupling
11 - Coolant pipe
12 - ATF cooler
♦ Only models with automatic transmission

G00282481

Fig. 12: Coolant Hose Routing Diagram (2.0L - Engine Code BDC)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

FUEL SYSTEM

FUEL PRESSURE

Specifications

FUEL PUMP PERFORMANCE & REGULATED FUEL PRESSURE(GASOLINE ENGINES)

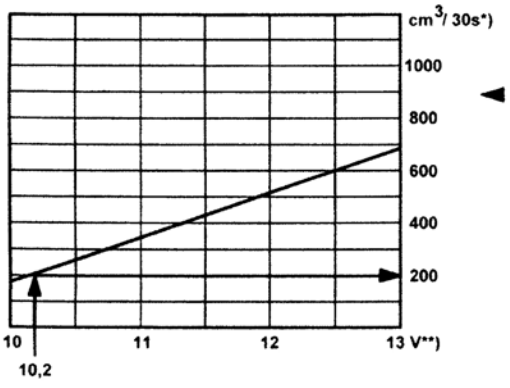
Application	Pressure At Idle - psi (bar)	(1) Volume In 30 Seconds	(4) Residual Pressure - psi (bar)
All Engines	(3) 36.3 (2.5)	(2)	29 (2.0)

(1) Volume is dependent upon battery voltage and should be checked with battery fully charged. See **Fig. 13** .

(2) Fuel pump volume depends on battery voltage at fuel pump. See **Fig. 13** .

(3) With vacuum hose disconnected at fuel pressure regulator, pressure is 43.5 psi (3.0 bar).

(4) Residual pressure is measured 10 minutes after engine or fuel pump is shut off.



- Fuel pump delivery range is dependent upon battery voltage

– Operate remote control for 30 seconds and note battery voltage.

– Compare quantity of fuel delivered with chart.

*) Minimum delivery cm^3/30 seconds

**) Voltage at fuel pump with engine not running and pump activated (approx. 2 Volts less than battery voltage).

Example:

During test, 12.5 Volts is measured at battery. The fuel pump voltage is approx. 2 Volts less than battery voltage equating to a minimum delivery of 530 cm^3/30 s.

If minimum delivery rate not obtained:

– Check fuel lines for possible restrictions (kinks) or blockage.

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Fig. 13: Measuring Fuel Pump Delivery Volume
Courtesy of VOLKSWAGEN UNITED STATES, INC.

IGNITION SYSTEM

FIRING ORDER

Illustrations

FIRING ORDER

Application	Firing Order
Beetle	
1.8L Turbo	(1) 1-3-4-2
1.9L Turbo Diesel	(2) 1-3-4-2
2.0L	(3) 1-3-4-2

(1) Coil-on-plug type ignition system is used. Cylinder No. 1 is at timing belt end of engine, and cylinder No. 4 is at flywheel end of engine.

(2) Cylinder No. 1 is located at timing belt end of engine. Cylinder No. 4 is located at flywheel end of engine.

(3) System uses a Distributorless Ignition System (DIS) with one ignition coil assembly. See **Fig. 14** for cylinder No. to coil identification. Cylinder No. 1 is located at timing belt end of engine. Cylinder No. 4 is located at flywheel end of engine.

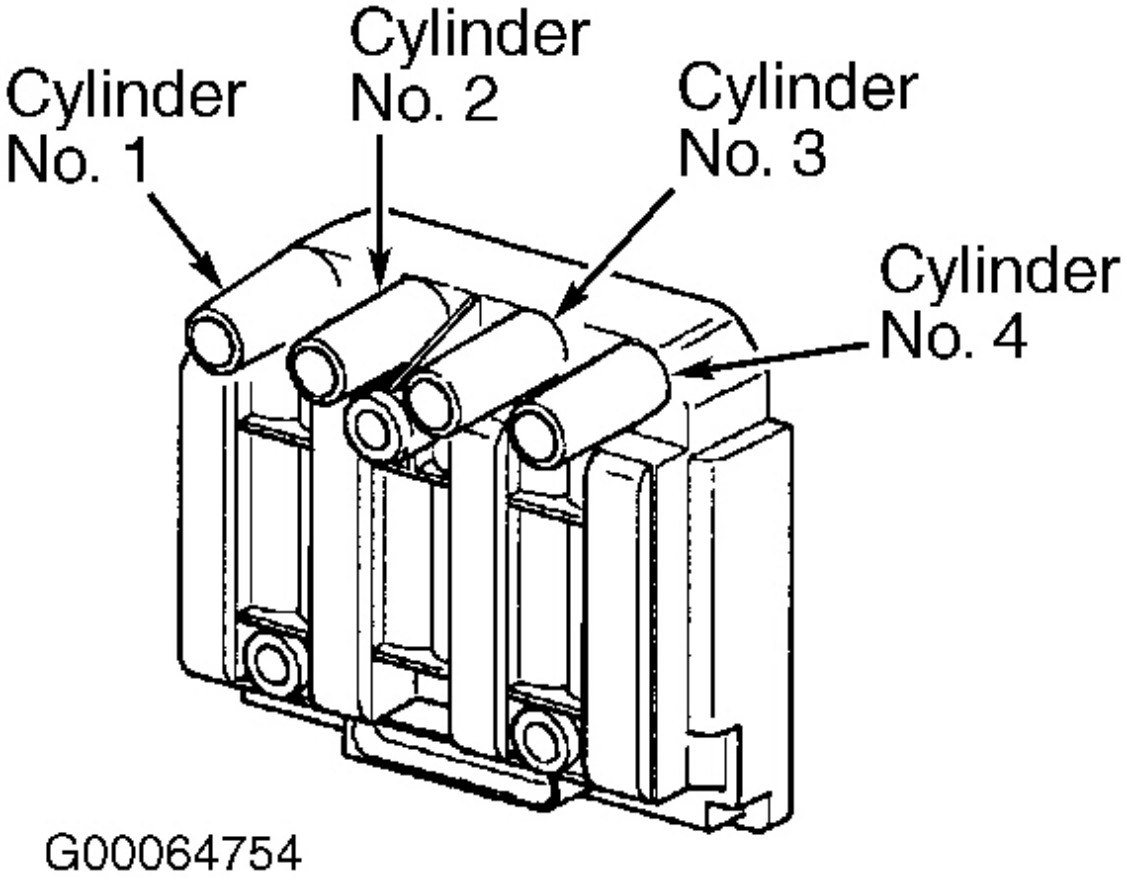

Fig. 14: Identifying Cylinder Numbers On Ignition Coil (2.0L - Engine Codes AVH & BDC)
Courtesy of VOLKSWAGEN UNITED STATES, INC.

HIGH TENSION WIRES

Resistance Specifications

HIGH TENSION WIRE RESISTANCE

Application	Ohms
Beetle	
2.0L (Engine Codes AVH & BDC)	(1) 4,000-8,000

(1) Measured with suppression connector and spark plug connector installed.

IGNITION COIL

NOTE: **Ignition coil resistance is not available from manufacturer for any engine.**

IGNITION TIMING

NOTE: **All engines are equipped with DIS. Ignition timing is not adjustable.**

SPARK PLUGS

All Specifications

SPARK PLUG TYPE

Application	NGK No.
Beetle	
1.8L Turbo (Engine Codes AWP)	PFR 6 Q
2.0L (Engine Codes AVH & BDC)	PZFR 5 D-11

SPARK PLUG SPECIFICATIONS

Application	Gap - In. (mm)	Torque - Ft. Lbs. (N.m)
Beetle		
1.8L Turbo (Engine Code AWP)	.032 (.80), Maximum	22 (30)
2.0L (Engine Code AVH)	.035-.043 (.9-1.1)	22 (30)
2.0L (Engine Code BDC)	.039-.043 (1.0-1.1)	18 (25)

STARTING SYSTEM

STARTER

Service Specifications

SERVICE SPECIFICATIONS (STARTER)

Application	Rating
1.8L & 2.0L Engines	12V, 1.0 Kw
1.9L Turbo Diesel	12 V, 1.8 Kw

Torque Specifications

TORQUE SPECIFICATIONS (STARTER)

Application	Ft. Lbs. (N.m)
All Engines	
Battery Cable Stud Nut On Solenoid	10 (13)
Starter Mounting Stud Nuts	44 (60)

WHEEL ALIGNMENT

For wheel alignment specifications and procedures, see **WHEEL ALIGNMENT SPECIFICATIONS** in SPECIFICATIONS & PROCEDURES article under WHEEL ALIGNMENT under SUSPENSION.